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Liverworts new to Colombia

Hepáticas nuevas para Colombia

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ABSTRACT

Based on our ongoing studies of the bryophyte flora of Colombia we report 15 liverwort species new to the country: *Archilejeunea nebeliana, Colura calyptrifolia, Dibrachiella auberiana, Fossombronia fernandeziensis*, *Isopaches bicrenatus, Lejeunea angusta, L. concinnula, L. corynantha, L. galeata, L. pulverulenta*, *L. serpillifolioides*, *L. tapajosensis, Leptoscyphus hexagonus, Marchesinia languida* and *Riccia planobiconvexa.* Notes are provided on the distribution, habitat and taxonomic differentiation of the species. *Lejeunea cochleata* is a new synonym of *L. angusta,* and *Taxilejeunea steyermarkii* is a new synonym of *Lejeunea pulverulenta*. With 730 species recorded, in 40 families, Colombia is probably the richest country in liverworts in tropical America.

Key words. Marchantiophyta, new floristic reports, taxonomy.

RESUMEN

Basado en nuestros estudios florísticos de briófitas en Colombia se registraron 15 especies de hepáticas nuevas para Colombia: *Archilejeunea nebeliana, Colura calyptrifolia, Dibrachiella auberiana, Fossombronia fernandeziensis*, *Isopaches bicrenatus, Lejeunea angusta, L. concinnula, L. corynantha, L. galeata, L. pulverulenta, L. serpillifolioides, L. tapajosensis, Leptoscyphus hexagonus, Marchesinia languida* y *Riccia planobiconvexa*. Se proporciona información del hábitat y distribución geográfica para todas las especies, así como también las diferencias taxonómicas. *Lejeunea cochleata* es un nuevo sinónimo de *L. angusta* y *Taxilejeunea steyermarkii* es un nuevo sinónimo de *Lejeunea pulverulenta.* Con unas 730 especies registradas, en 40 familias, Colombia es probablemente el país más rico en hepáticas en América tropical.

Palabras clave. Marchantiophyta, nuevos registros florísticos, taxonomía.

INTRODUCTION

Colombia has a very rich liverwort flora. With about 715 accepted species, in 40 families, the country ranks second among the countries of tropical America, after Brazil (725 spp.), and has more than half of the species recorded from tropical America (Gradstein 2016, Gradstein and Uribe-M. 2016). Based on our ongoing studies on the liverwort and hornwort flora of Colombia, several species new to science or new to the country were recently detected. The species new to science are published elsewhere (Gradstein and Reiner-Drehwald 2017a, b, Reiner-Drehwald and Gradstein in press). Here we present 15 species new to the country, together with notes on their taxonomy, geographical distribution and habitat (e.g., Fig. 1). The specimens have been deposited in the Herbarium of the Universidad Nacional de Colombia in Bogotá (COL), the Herbarium of Universidad Pedagógica y Tecnológica de Colombia in Tunja (UPTC) or the Centro de Colecciones Biológicas de la Universidad del Magdalena (CBUMAG), with duplicates in GOET and PC.

Figure 1. Localities of liverwort species new to Colombia. **a**. Montane rainforest near San Lorenzo, Sierra Nevada de Santa Marta (locality of *Lejeunea angusta*). **b**. Shrubby páramo at Cerro Ventanas, Tatamá (locality of *Leptoscyphus hexagonus)*. **c**. Río Gaira above Minca, Sierra Nevada de Santa Marta (locality of *Marchesinia languida*). **d**. Nursery along road Santa Marta to Riohacha (locality of *Riccia planobiconvexa*). Photographs by Claudia Morales (a, c, d) and Guido van Reenen (b).

ANNOTATED LIST OF SPECIES NEW TO COLOMBIA

Archilejeunea nebeliana Gradst. & Schäf.-Verw.

Putumayo: Mocoa, Vereda Campucana, carretera San Francisco-Mocoa, 01°12´26.6”N, 76°41´06.2”W, 1000 m, epiphytic, 4 oct 2016, *M.A. Suarez et al.*

253 (COL). **General distribution**: Ecuador (Gradstein and Schäfer-Verwimp 2012), Colombia (new).

Archilejeunea nebeliana is a rare submontane species from eastern slopes of the northern Andes; hitherto it was only known from the type from southern Ecuador. Characteristic are the pointed leaf apex, the emarginate underleaves and the very thin-walled, colorless lobule cells without trigones (Gradstein and Schäfer-Verwimp 2012, Shi and Zhu 2015).

Colura calyptrifolia (Hook.) Dumort.

Casanare: along road Socha to Sácama, 3000 m, on thin twigs at the edge of disturbed *Weinmannia* forest, 4 aug 2017, *S.R. Gradstein 12708* (COL). **Risaralda**: Santa Rosa de Cabal, finca La Sierra, 3750 m, on twigs, 1980, *J. Aguirre & S.R. Gradstein 4948a* (COL, GOET). **General distribution**: oceanic and cool-temperate regions of South America, West Indies, tropical Africa and western Europe (Gradstein *et al.* 1983).

Colura calyptrifolia is rare in the Andes where it occurs at high elevation, mostly above 3000 m. Characteristic is the sac with a linear prolongation, which measures less than half the length of the whole leaf. *Colura calyptrifolia* is close to the pantropical *C. tenuicornis* but in the latter species the prolongation of the sac is longer and measures more than half the length of the whole leaf. Moreover, the transition between sac and prolongation is gradual in *C. tenuicornis* whereas in *C. calyptrifolia* the transition is abrupt. *Colura tenuicornis* grows at lower elevations than *C. calyptrifolia*.

Dibrachiella auberiana (Mont.) Shi *et al.*

Chocó: road Tutunendo - El Carmen at point 20, ca. 425 m, on tree trunk in rather open, logged rainforest, aug 1992, *S.R. Gradstein 8940b* (GOET). **General distribution**: widespread in tropical America (Gradstein 1994); new to Colombia.

Dibrachiella auberiana (=*Archilejeunea auberiana* [Mont.] A.Evans) is a rather common neotropical epiphyte from relatively dry, exposed habitats at low elevations. The species is recognized by the small, pale-green plants with ovate, entire-margined leaves, undivided underleaves, longly rectangular, 2-toothed lobules that are sometimes reduced, isodiametric leaf cells with simple-triangular trigones, stems without enlarged epidermis and a 5-keeled perianth subtended by 1-2 lejeuneoid innovations. *Dibrachiella auberiana* is close to *D. bischleriana* (Gradst.) Shi *et al*., a species endemic to the Chocó of Colombia, but the latter species has smaller lobules with only one tooth and reniform underleaves (Gradstein 1994 as *Archilejeunea bischleriana*).

Fossombronia fernandeziensis Steph.

Cundinamarca: Páramo de Palacio, 3375 m, on soil, 22 may 1972, *A.M. Cleef 3966*, det. B.J. Crandall-Stotler (ABLS, COL, GOET, U). **Nariño**: Páramo La Pastora, 2968 m, over soil along trail, 19 apr 2009, *J.C. Benavides 4064*, det. B.J. Crandall-Stotler (F-ABLS). **Tolima**: above St. Isabel, in páramo, 3560 m, on soil, 29 jul 1980, *J. Aguirre & S.R. Gradstein 1616*, verif. B.J. Crandall-Stotler (ABLS, COL, GOET, U). **General distribution**: tropical Andes, Juan Fernandez Islands (Freire 2002); new to Colombia.

Fossombronia fernandeziensis is an uncommon Andean species that is characterized by: 1) leaves distinctly longer than wide, plane or slightly undulate, margins entire, bordered by elongate cells; 2) tubers produced at shoot apex; 3) plants monoicous, antheridia and archegonia scattered; 4) outer spore surface densely lamellate, margin with (18-)21-28 spines; 5) elaters with 2 spirals (Freire 2002).

Isopaches bicrenatus (Hoffm.) H.Buch

Caldas: Manizales, Nevado del Ruiz, "bifurcación camino El Refugio – La Olleta", 4550 m, on soil under rock, 14 sept 1984, *E. Linares, J. Aguirre, S.R. Gradstein & B.O. van Zanten 1428 (*COL). **General distribution**: widespread in temperate regions of the Northern Hemisphere, furthermore known from SE Brazil, New Zealand and from high elevation, above 4000 m, in the northern Andes (Benitez *et al.* 2012); new to Colombia.

Isopaches bicrenatus is a common holarctic species that had been recorded once in the northern Andes (Benitez *et al.* 2012). The plants are small, ca. 1 mm wide or less, paroicous, creeping and yellowish-brownish in color, the leaves are subtransverse and imbricate, bifid to 1/3 with obtuse apices and with masses of reddish-brown gemmae at the leaf margins.

Lejeunea angusta **(**Lehm. & Lindenb.) Mont.

Jungermannia angusta Lehm. & Lindenb. Type: Mexico, Xalapa, without collector (isotype, PC-Mont. 2118!).

Lejeunea cochleata Spruce, **syn. nov.** Lectotype (**designated here**): Ecuador, Mt. Tungurahua, *Spruce L480* (MANCH 000119!, autoic.; isolectotype, distributed as "*Hepaticae Spruceana: Amazonicae et Andinae*", MANCH 0000118 !, ster.). Syntype: Ecuador, Mt. Chimborazo, *Spruce L526* (MANCH, 000120! autoic.; isosyntype, MANCH 000121!, autoic.).

Magdalena: Sierra Nevada de Santa Marta, San Lorenzo, 2250 m, on shaded rock at the edge of humid montane rainforest, growing in a bryophyte mat, with *Notoceros aenigmaticus,* 14 nov 2015, *S.R. Gradstein, C. Morales & M. Negritto 12542* (CBUMAG, PC). **General distribution**: scattered in tropical America (Schäfer-Verwimp *et al.* 2013); new to Colombia.

Lejeunea angusta is readily recognized by the very small plants (less than 1 mm wide) with strongly convex, wide-spreading leaf lobes with rounded tips and entire margins, large swollen, ovoid lobules (ca. 1/3× leaf length), leaf cells with uniformly thickened walls and a finely punctate-papillose cuticle, very small underleaves (1.5-2× stem width), and numerous denuded, flagelliform branches without leaves (only with underleaves). *Lejeunea angusta* closely resembles *L. aphanes* Spruce but in the latter species the apical cells of underleaves are more thin-walled than adjacent cells (and often broken) and flagelliform, denuded branches are lacking. By its caducous leaves and ± uniformly thickened cell walls *L. angusta* is also similar to *L. deplanata* Nees but the latter species is a larger plant (to 1.5 mm wide) with larger underleaves (2.5-5× stem width) and a smooth cuticle. Moreover, in *L. deplanata* only the leaf lobes are dropping off, not the lobules.

Lejeunea concinnula Spruce & Steph.

Cundinamarca: Laguna de Pedro Palo, 2060 m, in *Quercus* forest, 11 jun 1967, *T. van der Hammen 1665a*, det. M.E. Reiner-

Drehwald (COL, GOET). **Magdalena**: near San Lorenzo, 2000 m, humid montane forest along the road from Minca to San Lorenzo (Fig. 1), on litter in deep shade, 14 nov 2015, *S.R. Gradstein et al. 12578*, det. M.E. Reiner-Drehwald (as "cf.") (CBUMAG, PC). **Valle**: 3 km SW of Betania, 1970 m, on tree trunk in humid subandean forest, 4 apr 1972, *A.M. Cleef & A.M. van Rens 2733b*, det. M.E. Reiner-Drehwald (COL, GOET). **General distribution**: Venezuela (type), Colombia (new).

Lejeunea concinnula is a rare Venezuelan species that is newly reported for Colombia. The species resembles *L. laetevirens* Nees & Mont. in the very small plants (less than 1 mm wide) with suberect to obliquely spreading, ovate-oblong leaves, rather large lobules (1/3× lobe length) and a punctate-papillose cuticle. *Lejeunea concinnula* differs from *L. laetevirens*, however, by caducous leaves and uniformly thick-walled leaf cells.

Lejeunea corynantha Spruce

Casanare: road Socha to Sácama, 3000 m, on thin twigs at the edge of disturbed *Weinmannia* forest, 4 aug 2017, *S.R. Gradstein 12706* (COL). **General distribution**: West Indies, Panama, northern Andes (Reiner-Drehwald and Schäfer-Verwimp 2008, Gradstein and Benitez 2017); new to Colombia.

Lejeunea corynantha is a rare Caribbean species that had been recorded once from páramo in Ecuador (Gradstein and Benitez 2017). The species resembles *L. capensis* Gottsche in the terete perianth but differs from the latter by having larger lobules (1/2× lobe length), smaller underleaves (ca. 2× stem width), strongly convex leaf lobes and a more longly exserted perianth without beak (Reiner-Drehwald and Schäfer-Verwimp 2008).

Lejeunea galeata Spruce

Chocó: road St. Cecilia to Tado 40 km, 200 m, in lightly logged, rather wet and mossy rainforest, on trunk, jul-aug 1992, *S.R. Gradstein 8722* (COL, GOET). **General distribution**: Colombia (new), Ecuador, northern Peru (Schäfer-Verwimp *et al.* 2013).

Lejeunea galeata is a rare and little-known northern Andean species that is recognized by the very small plants (0.4-0.8 mm wide) with orbicular leaf lobes that are strongly caducous.

Lejeunea pulverulenta **(**Steph.) M.E.Reiner

Taxilejeunea steyermarkii H.Rob., **syn. nov**. Type: Venezuela, "Yaracuy, selva nublada, El Ampato, 7-11 km al norte de Salom, Distrito Nirgua, 1200-1300 m", *J. Steyermark 111484a* (holotype, US, n.v.).

Risaralda: Western Cordillera, Mistrató, trail Geguades to Puerto de Oro, 1500 m, on shaded rock in undisturbed lower montane cloud forest, jul 1992, *S.R. Gradstein 8448* (COL, GOET, as *T. steyermarkii*). **General distribution**: scattered in the Neotropics (Reiner-Drehwald 2005), distribution insufficiently known; new to Colombia.

Lejeunea pulverulenta is a little-known neotropical species that was in the northern Andean region only known by a single collection from Ecuador (Reiner-Drehwald 2005). In Colombia it had been recorded as *Taxilejeunea steyermarkii*, a species otherwise known only from the type from Venezuela. Judging from the original description and illustration (Robinson

1976), *T. steyermarkii* is identical to *L. pulverulenta* and a new synonym.

Lejeunea pulverulenta is readily recognized by the underleaves with a strongly cordate-auriculate base, rounded leaf tips, crenulate leaf margins, elongate leaf-lobe cells which become conspicuously smaller towards to the leaf margin, finely papillose cuticle, autoicy and perianths with slightly toothed keels. The species resembles the common *L. cerina* (Lehm. & Lindenb.) Lehm. & Lindenb. but the leaf apex in *L. cerina* is usually pointed (broadly rounded in *L. pulverulenta*) and the underleaves in *L. cerina* are not or only slightly auriculate. Moreover, *L. cerina* is dioicous.

Taxilejeunea (Spruce) Steph. has long been recognized as a separate genus close to *Lejeunea* but recent molecular studies have shown that the genus is nested in *Lejeunea* and does not deserve recognition (Wilson *et al.* 2007, Heinrichs *et al.* 2013).

Lejeunea serpillifolioides (Raddi) Gradst. **comb. nov.**

Jungermannia serpillifolioides Raddi, Critt. Brasil.: 1. 1822. *Taxilejeunea isocalycina* (Nees) Steph., *T. serpillifolioides* (Raddi) D.P.Costa

Santander: Bolívar, Estación Santa Rosa, 1600 m, on wet rocks and trunk bases in montane rainforest, sept 2014, *J. Gil 2085, 2086, 2920* (UPTC). **General distribution**: tropical America (Gradstein and Costa 2003, as *Taxilejeunea isocalycina*); new to Colombia.

Lejeunea serpillifolioides (= *Taxilejeunea isocalycina*) is a common neotropical member of the former genus *Taxilejeunea*, occurring on bark of trees and shrubs and on rock, often in open environments and along rivers but also in the interior of forests. It is surprising that the species had not yet been recorded from Colombia. The species is readily recognized by the rather long and slender stems, the obliquely spreading ovate leaves with rounded to apiculate tips, crenulate margins without or with 1-2 small teeth near the apex, very thin-walled cells and reduced lobules, the large, imbricate underleaves (5-7× stem width) with a shortly bifid apex and large auricles, and the seriately arranged perianths without keels. *Lejeunea serpillifolioides* is very close to *L. sulphurea* (Lehm. & Lindenb.) Spruce, which is known from Colombia, but in the latter species the leaf margins are more conspicuously toothed. Possibly, *L. sulphurea* is a variety of *L. serpillifolioides*.

Lejeunea tapajosensis Spruce

Risaralda: Western Cordillera, Mistrató, trail Geguades to Puerto de Oro, 800 m, lightly logged submontane forest, on branches and twigs in the forest canopy and on poles in the forest understory, jul 1992, *S.R. Gradstein 8628, 8640, 8643*, det. E.M. Reiner-Drehwald (COL, GOET). **General distribution**: tropical South America, Jamaica (Schäfer-Verwimp and van Melick 2016); new to Colombia.

Lejeunea tapajosensis is a common tropical South American species with caducous leaves. The species is very similar to *L. phyllobola* Nees & Mont. – both species share androecia with underleaves present throughout the male spike – but *L. tapajosensis* differs from *L. phyllobola* by larger plant size (1-1.5 mm wide), larger underleaves (ca. 3-4× stem width) with broadly rounded-quadrate bases, and leaf cells with elongate, radiate trigones (Reiner-Drehwald 2000). *Lejeunea tapajosensis* also resembles the Amazonian *L. rionegrensis* Spruce but the latter species has fully

thin-walled leaf cells, without trigones and intermediate thickenings (Reiner-Drehwald and Schäfer-Verwimp 2008). *Lejeunea rionegrensis* is not known from Colombia but is expected to occur in the Colombian Amazon.

Leptoscyphus hexagonus (Nees) Grolle

Chocó: Tatamá, NE of Cerro "Ventanas" (Fig. 1), 3860 m, in shrubby bamboo páramo ("chuscal"), 11 feb 1983, *G. van Reenen & J. Aguirre 5088, 5100* (COL, U). **General distribution**: northern Andes (Schäfer-Verwimp *et al.* 2013); new to Colombia.

Leptoscyphus hexagonus is a characteristic, robust epiphyte of upper montane forests and shrubby páramo in the northern Andes (2500-4000 m). The species is recognized by its glossy brown color, the convex and ± appressed, asymmetrical leaves with an expanded ventral portion of the lamina and an auriculate base without or with a short tooth. The leaf cells have large, bulging trigones and the underleaves are large (2-5× stem width), bifid to less than half (1/4-1/3) of underleaf length and with one or several long teeth of the outer margins. *Leptoscyphus hexagonus* is closely related to *L. jackii* (Steph.) Grolle, *L. gibbosus* (Taylor) Mitt. and *L. sotiauxii* Vanderp. *et al.* (Vanderpoorten *et al.* 2010), but *L. jackii* differs in the smaller plant size (2-3 mm wide), smaller leaf cells (20-30 µm) and presence of 1-3 long teeth at the ventral leaf base whereas *Leptoscyphus gibbosus* and *L. sotiauxii* differ by straight ventral leaf bases, without auricle and without any teeth. For an updated key to the species of *Leptoscyphus* in the northern Andes see Gradstein and Benitez (2017).

Marchesinia languida (Nees & Mont.) Steph.

Cundinamarca: Laguna de Pedro-Palo, 2000 m, 5-7 August 1959, *H. Bischler 3030* (PC), ibid., terrestrial, in shade, a few stems mixed between *Lejeunea cerina*, 21 apr 1959, *H. Bischler 2219 p.p.* (PC). **Magdalena**: Minca, Hacienda La Victoria, along Río Gaira (Fig. 1), 11°07'20,4''N 74°05'06,9"W, 1162 m, on rock in the river, 24 may 2013, *C. Morales 09* (CBUMAG-BRY00114, PC), ibid., 910 m, *C. Morales 022* (CBUMAG-BRY00126, PC). **General distribution**: Central America, tropical Andes (Gradstein 2012); new to Colombia.

Marchesinia languida is rather widespread in Central America and the tropical Andes but was not yet known from Colombia. The species had been considered a synonym of *M. brachiata* (Sw.) Schiffn. but molecular-phylogenetic analysis showed that it merits recognition (Heinrichs *et al.* 2009). *Marchesinia languida* is recognized by the flat underleaves (recurved in *M. brachiata*), underleaf bases cuneate to auriculate and leaves rather fragile with longly apiculate to cuspidate tips and with a few teeth measuring 1-6(-10) cells in length. The leaf tips and teeth are often broken in herbarium material, however, and this may lead to confusion with *M. bongardiana* (Lehm. & Lindenb.) Trevis. which shares flat underleaves and fragile leaves with *M. languida*. However, the leaf apex in *M. bongardiana* is shortly apiculate (not cuspidate), the teeth are only 1-2 cells long and the underleaf bases are cuneate to rounded, not auriculate (Gradstein and Uribe in prep.).

Riccia planobiconvexa Steph.

Magdalena: along road Santa Marta to Riohacha km 29, ca. 140 m, on bare soil at the entrance of a nursery (Fig. 1), 13 nov 2015, *S.R. Gradstein, C. Morales & M. Negritto 12519* (CBUMAG, PC). **General distribution:** common in subtropical South America (SE Brazil, Paraguay, N Argentina), rare elsewhere (Costa Rica, Galápagos Is.) (Bischler *et al*. 2005); new to Colombia.

Riccia planobiconvexa is a species of moist sandy soil in cultivated areas at low elevations, from sea level to ca. 1200 m (Bischler *et al*. 2005). It is recognized by the rather robust thalli (1.5-3 mm wide, 3-5× wider than high) made up of fully thin-walled cells (vertical thickening strips are absent), small hyaline scales and dark reddish-brown, wingless spores with 8-11 areoles across the face. The species is probably more common in the Caribbean lowlands of Colombia and has been overlooked.

CONCLUSION

With 15 new species added to the flora the total number of liverwort species recorded from Colombia has risen to 730. The number of liverwort species recorded from Colombia thus exceeds that of Brazil, considered the richest country in tropical America for liverworts (Gradstein 2016). The new additions on the one hand demonstrate the extraordinary rich flora of Colombia (Bernal *et al*. 2016), on the other hand indicate that the bryophyte flora of this country is still incompletely known.

AUTHOR´S CONTRIBUTION

SRG collected material, made identifications and wrote the article; JU, JG, CM and MN collected material and provided information on the specimens.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests

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